Endovascular repair of *Salmonella*-infected abdominal aortic aneurysms: A word of caution

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Over the last several years, treatment modalities have changed for infected aortic aneurysms. Surgical treatment has undergone a paradigm shift from débridement and extra-anatomic bypass to direct reconstruction to, most recently, endovascular repair. Although many reports of endovascular repair of such aneurysms are favorable, the following two cases highlight some of the concerns with endografts in an infected field. Specifically, we urge caution when considering endovascular repair of *Salmonella*-infected arterial pathologies. (J Vasc Surg 2006;44:198-200.)

Historically, the preferred surgical treatment of infected aortic aneurysms included the oversewing of noninfected vessels, extensive débridement, and extra-anatomic revascularization remote from the infected field. The universal requirement for these basic surgical tenants has been challenged with the increasingly common adoption of direct reconstruction with synthetic or autologous conduits that have acceptable short- and mid-term outcomes.[1,2] Changes in surgical management have coincided with the progression of this disease process from one of primarily *Salmonella* involvement to one of *Staphylococcus* infection.[3]

More recently, the treatment of these infected aneurysms has undergone another paradigm shift with the adoption of endovascular repair methods.[4-13] Although numerous reports have displayed good technical success with acceptable short-term outcomes, longer-term data are currently lacking. The specific role for this technology in such infected fields remains to be definitively determined.[14] In fact, it is possible that the optimal treatment of such infected aneurysms might depend on, among other factors, the infective organism itself. Specifically, although successful endovascular management of *Salmonella* infected aneurysms has been reported,[4,12,13] we recommend caution based on our experience with the following two cases.

CASE REPORTS

Case 1. A previously well 73-year-old man presented with a 55-mm infrarenal abdominal aortic aneurysm and recently treated *Salmonella enteritidis* gastroenteritis. He underwent an attempt at open repair of his aneurysm at another institution. This was abandoned when a dense inflammatory reaction and brownish retroperitoneal fluid were encountered. He was transferred to our center for consideration of endovascular repair.

His computed tomography (CT) scan revealed an infected-appearing process with pseudoaneurysm formation (Fig 1). Successful endovascular repair followed using a Talent (Medtronic AVE, Santa Rosa, Calif) aortouniiliac endograft with a contralateral iliac occluder and a femorofemoral crossover graft because of a concern about the ability of the narrow aortic bifurcation to accommodate two limbs of a bifurcated device. He continued to receive ampicillin to which the *Salmonella* was sensitive.

He was relatively healthy for 3 years after, but he presented on several occasions with clinical signs of bacteremia and sepsis. His CT scan was unremarkable. Blood cultures grew enteric organisms. Concern about an aortoenteric fistula prompted an upper endoscopy that revealed clot and a visible endograft in the third part of the duodenum.

Four years after his initial endovascular repair, the patient underwent removal of the endograft, closure of the infrarenal aortic stump, and duodenum and lower extremity revascularization via an axillobifemoral bypass graft. The fistula appeared to be towards the proximal end of the endograft fabric, with no extruding bare metal stent. Aortic wall specimens failed to grow any organisms upon culture. He remains well and free of infection 1 year later.

Case 2. A frail, 83-year-old woman presented to our emergency department with a history acute back pain. A CT scan revealed a penetrating ulcer and pseudoaneurysm of the infrarenal abdominal aorta (Fig 2). No signs or symptoms of an infectious process were present, but an infected aneurysm was considered. Laboratory results and blood cultures proved negative.

Given her frailty and age, she underwent successful endovascular repair of this lesion with a Talent aortouniiliac endograft with a contralateral iliac occluder and a femorofemoral crossover graft. As with the previous case, a narrow aortic bifurcation prompted the use of an aortouniiliac device.

She did well initially, but presented 5 months later with signs of sepsis and bacteremia determined to be secondary to *S enteritidis*. Long-term ciprofloxacin antibiotic therapy was instituted. A subsequent CT scan revealed a new perigraft contrast leak and several retroperitoneal fluid collections. Operative intervention including endograft explantation was discussed, but given her comorbidities, the patient refused.

Despite continuing treatment with ciprofloxacin, a CT scan 3 months later showed progression of a suprarenal infected-appearing aortic aneurysm with at type I endoleak (Fig 3). This visceral aortic involvement was not apparent before endograft implantation. The patient continues to be observed, but refuses further intervention.

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Competition of interest: none.

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0741-5214/$32.00

doi:10.1016/j.jvs.2006.03.002

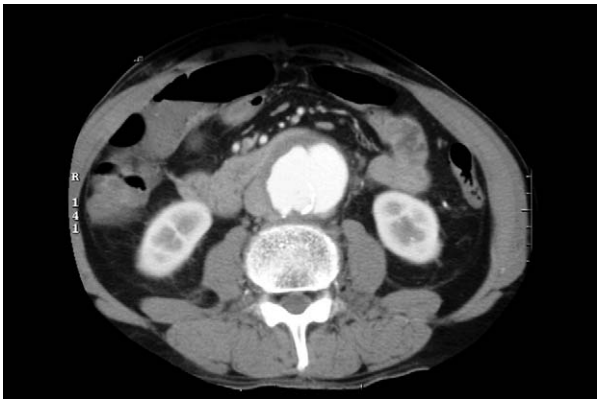

Fig 1. *Salmonella* infected abdominal aortic aneurysm.

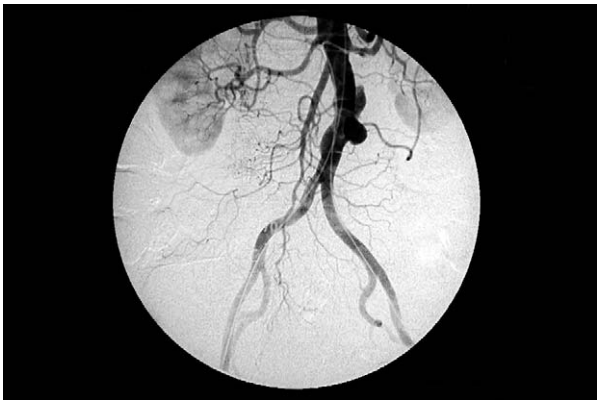

Fig 2. Penetrating ulcer and pseudoaneurysm of the infrarenal abdominal aorta.

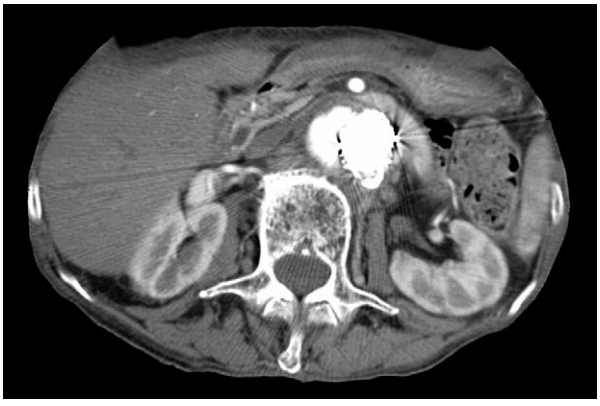

Fig 3. Degeneration of the suprarenal abdominal aorta secondary to *Salmonella* after endovascular repair.

DISCUSSION

Salmonellae are gram-negative anaerobic bacteria whose clinical manifestations include an aortitis that can result in new aneurysm (or pseudoaneurysm) formation or infection of a previously existing aneurysm.[15,16] Soravia-Dunand et al[17] reviewed reports published since 1948 and identified 140 cases of *Salmonella* aortitis. They noted a clear male predominance (76%), with a mean age of 61 years (range, 32 to 86 years) and a symptomatic prodrome before definitive diagnosis of up to 8 months. The abdominal aorta was involved in 88% of the cases, with blood and stool cultures proving positive for *Salmonella* species in 85% and 65% of cases, respectively. The most commonly isolated organism was *S typhimurium* (31%), followed by *S enteritidis* and *S choleraesuis* (both 16%).

In an examination of treatment modalities, these authors reported dismal results with medical management alone.[17] Of patients treated with antibiotics alone, 96% died, and 70% of them ruptured their aorta. In contrast, those treated with a combined medical (antibiotics) and surgical approach faired much better. Fifty-four patients underwent direct prosthetic reconstruction with a 46% mortality rate, over half of which was attributed to recurrent infection or anastomotic rupture. Only 30 patients underwent surgical débridement and extra-anatomic arterial reconstruction but achieved the lowest mortality rate of 23%. As a result, the authors recommend a combined medical and surgical approach to infrarenal *Salmonella* aortitis, including aortic ligation, retroperitoneal débridement, extra-anatomic revascularization, and bactericidal antibiotic therapy for at least 6 postoperative weeks. Evidence to support longer-term suppressive antibiotics proved less convincing.

Since then, experience with direct synthetic or autologous reconstruction of infected aneurysms has increased, with promising results.[1,2] As a natural extension of this progression, several centers have reported encouraging short- and mid-term results with endovascular repair of infectious aortic pathologies.[4-13]

Our center's prior experience was limited to a few cases involving *Staphylococcus* organisms, similar to most reported cases. The obvious advantage of this technique is its less invasive nature in ill patients with bacteremia and septic manifestations. However, this short-term benefit may be surpassed by the disadvantages surrounding a lack of surgical débridement, which in the longer term, may not offer complete protection from further aortic wall deterioration and resulting septic and hemorrhagic complications. Certainly, more extensive follow-up, longer then currently reported, is necessary before the role of this technique with infectious processes can be clarified.[14]

Of the reported cases regarding endovascular repair of infected aneurysms, few have specifically involved *Salmonella*.[4,12,13] Two of four reported cases involving this organism had hemorrhagic and septic complications requiring reintervention, and most reported cases have limited follow-up.

In their series of nine patients, Jones et al[4] described two patients with *Salmonella* involvement initially successfully treated with endografts. One patient, however, had recurrent bleeding that required placement of an aortic cuff. Both patients were reported well after 27 and 36 months. Koeppel et al[12] reported the successful endovas-

cular repair of a similar aortic aneurysm that was complicated by recurrent retroperitoneal abscesses requiring drainage. Although the patient recovered, follow-up was limited to 1 year. Ting et al[13] described an additional endovascular repair of a *Salmonella* thoracic aneurysm with 1-year follow-up and no reported complications.

These reports serve to illustrate that experience with this organism and endografts is limited and less than ideal, with short follow-up and less-than-ideal protection from hemorrhagic and septic complications.

Our experience with the present cases is representative of these concerns. Our first patient continued to have manifestations of bacteremia 3 years after the initial repair. An aortoenteric fistula had developed, and although this has been reported periodically after endovascular repair of degenerative aneurysms, it has been seen in up to 13% of *Salmonella* infected aneurysms.[17] Although not pathognomonic of *Salmonella* infection, fistula development is more common with such infected aneurysms, and with no evidence of any structural causes, *Salmonella* infection is presumed to be the etiology of its development in this patient. This patient did not recover until the endograft was explanted.

Our second patient's blood cultures did not grow *Salmonella* until after her endovascular repair, but it is likely she harbored this organism at the time of her repair as her preoperative imaging revealed a pseudoaneurysm of the infrarenal aorta compatible with infectious etiology. Unfortunately, her infectious aortic process has caused further aortic destruction and impending hemorrhage as she refuses further surgical management. In retrospect, this late identification of *Salmonella* as the causative organism precluded us from an initial open repair, which we would now advocate in the presence of this organism.

CONCLUSION

Infectious aortic processes continue to offer challenging scenarios with risks of major morbidity and mortality. Although endovascular repair offers short-term attractiveness with its less invasive nature, it should also be viewed as less definitive until longer-term follow-up is available. Specifically, we recommend considerable caution when considering this approach with *Salmonella* infections, as significant septic and hemorrhagic complications can result. This experience leads us to recommend open aneurysm repair in the presence of *Salmonella* infection. Alternatively an endograft might be used as a temporary solution while recognizing the eventual need for endograft explantation and definitive treatment.

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Submitted Jan 11, 2006; accepted Mar 6, 2006.